Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Wireless Operations in the 3650-3700 MHz Band	)	ET Docket No. 04-151
	)	
	)	WT Docket No. 05-96
Rules for Wireless Broadband Services in the 3650-3700 MHz Band	)	
	)	
	)	ET Docket No. 02-380
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band	)	ET Docket No. 98-237
	)	
Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band	)	

PETITION FOR RECONSIDERATION OF
INTEL CORPORATION
REDLINE COMMUNICATIONS INC.
ALVARION, INC.

June 10, 2005

EXECUTIVE SUMMARY

In the *NPRM* and *Order* in this proceeding, the FCC set forth two primary objectives for the 3650-3700 MHz band ("3650 MHz band"): (i) provide expeditious, low cost access to the band for rural wireless Internet service providers ("WISPs") and (ii) promote efficient use of the band in congested areas. In an effort to achieve these laudable goals, the *Order* adopted new rules for the 3650 MHz band which provide for nationwide, non-exclusive licensing of terrestrial operations, utilizing a contention-based protocol requirement and related sharing provision (hereinafter, the "contention-based protocol"). While Petitioners support the Commission's laudable objectives, we do not believe that the rules will achieve the agency's stated goals. In fact, we believe that the rules will have significant unintended negative consequences for the deployment of wireless broadband services in both rural and congested areas.

Squatting and Inefficient Use. The contention-based protocol and key ambiguities in the new rules will lead to squatting by competing providers. For example, the rules will encourage "squatting" applications for stations that will provide little, if any, service – for the sole purpose of impeding entry by others. The rules attempt to deal with this situation by requiring licensees to delete registrations for unused stations, but fail to define the term "unused" or set a time limit for deletion. Thus, the rules will encourage

users to engage in another form of squatting – in this case, failing to delete unused stations – in order to prevent others from entering the market.

In addition, significant ambiguities in the new rules will lead to inefficient use of the 3650 MHz band. For instance, the rules state that licensees should make "every effort" to minimize interference, but fail to define the key phrase "every effort." If the FCC fails to clarify this obligation, it will likely lead to squatting by incumbents. On the other hand, if the Commission interprets the obligation too strictly – for example, requiring new entrants to take all technically feasible actions to avoid interference – it will erect barriers to effectively preclude new users from entering the market.

Administrative Delay. Critical ambiguities in the new rules are likely to lead to confusion and disputes that could significantly slow the launch of new services in rural areas. For example, the rules require registration of certain stations before use, but do not set forth a time frame for launching service. Also, as noted above, the rules require licensees to delete registrations for unused stations, but do not define "unused" or set a time limit for deletion. Additionally, as noted above, the FCC does not define the obligation of new users to make "every effort" to minimize interference. All of these ambiguities can be expected to create substantial disputes and additional investment risk.

Moreover, in order for the administrative approval process for the contention-based protocol to have any "teeth," it will likely take a significant

amount of time to complete. Under the new rules, the FCC will have to determine at the time of application whether the specific technology proposed complies with the contention-based protocol. Also, users are likely to try to "game" the system in order to achieve a marketplace advantage. If recent standards and testing activity is any indication, debates could drag on for years regarding 3650 MHz band threshold levels, signatures needed to assure non-interference, and testing methods for determining compliance with the new rules.

"Tragedy of the Commons." The Commission suggests that a "listen before talk" ("LBT") contention-based protocol, as used by unlicensed Wi-Fi devices, provides a good model for the 3650 MHz band. However, LBT only works well for short range, low power applications like Wi-Fi where control resides in one entity or operator-to-operator voluntary cooperation is feasible. Indeed, when WISPs in congested areas attempt to use unlicensed, or non-exclusively licensed, bands – where there can be dozens or even hundreds of simultaneous users – "tragedy of the commons," or significant interference, issues tend to emerge often rendering the network virtually useless. Accordingly, LBT will not work well for long range, high power services such as those envisioned in the 3650 MHz band, including WiMAX, where there will be significant contention among competing uses.

In addition, in order for LBT to work effectively, a device must be able to sense the signals of other receivers in its area at a very low threshold.

Thus, LBT works well for Wi-Fi because the base stations and client devices are almost always very close in proximity (typically only tens of meters apart) – so detection at a very low threshold is feasible. Yet, in the case of the longer range services anticipated in the 3650 MHz band, the potential victim receivers could be located hundreds or thousands of meters away from the companion base station and could be transmitting a relatively weak signal – such that detection at a very low threshold would be highly unlikely.

Furthermore, directional antennas are a key component of long range wireless broadband applications like those envisioned in the 3650 MHz band. However, such antennas can only "listen" in one direction, and LBT requires omnidirectional "listening" in order to work effectively. This incompatibility is one more reason that LBT contention-based protocols will not work well with long range wireless broadband applications such as those anticipated in the 3650 MHz band, including WiMAX.

Proposed Rules. Petitioners recommend that the Commission promptly reconsider its *Order* and modify its rules for the 3650 MHz band by removing the contention-based protocol for all markets (*i.e.*, rural and congested areas). We also propose that the signal strength limit be set at 47 dBμV/m in order to facilitate the efficient resolution of interference issues and allow for the co-existence of exclusive and non-exclusive licensed use in adjacent areas. We further recommend that the power limit be increased to a maximum 5 watt EIRP over a 25 megahertz bandwidth for mobile units in

non-exclusive licensed use in order to provide more meaningful coverage in rural areas.

Moreover, in large urban areas where contention is likely, Petitioners propose that the FCC modify the new rules to prescribe exclusive licensed use in the Top 50 Metropolitan Statistical Areas ("MSAs"). Specifically, we believe that two blocks of 25 megahertz each should be exclusively licensed in these markets. Exclusive licensing will foster the most efficient use of spectrum in these markets. It will solve "tragedy of the commons" problems, promote optimal quality of service, and create strong business investment certainty – thereby best fostering long range, wireless broadband deployment in these more crowded areas. Furthermore, exclusive licensing in the Top 50 MSAs should not create significant market power problems; to the contrary, it will offer an additional broadband alternative and thus introduce more competition.

Pursuant to these modified rules, the 3650 MHz band will be allocated in a manner which will meet the FCC's dual goals. Indeed, the modified rules will encourage expeditious, low cost access to this spectrum for rural WISPs and promote efficient use of this spectrum in congested areas.

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PETITION FOR RECONSIDERATION OF
INTEL CORPORATION
REDLINE COMMUNICATIONS INC.
ALVARION, INC.

I. INTRODUCTION

Intel Corporation ("Intel"), Redline Communications Inc. ("Redline"), and Alvarion, Inc. ("Alvarion") (together, "Petitioners") hereby submit the following Petition for Reconsideration of the *Report and Order and Memorandum Opinion and Order* released in the above-referenced

proceeding of the Federal Communications Commission ("FCC" or "Commission").[1]

Intel is the world's largest semiconductor manufacturer and a leader in technical innovation. Intel is also a leading manufacturer of communications and networking chips and equipment. Redline is a leading manufacturer of broadband wireless access and backhaul systems. Alvarion is the world's largest pure play provider of wireless broadband networking infrastructure to carriers, ISPs, and private network operators.
Alvarion offers premier wireless broadband solutions for access in the last mile, backhauling connection to the backbone and private network connectivity.

Petitioners support the laudable goals that the Commission seeks to accomplish in adopting new rules for the 3650-3700 MHz band ("3650 MHz band"): (i) provide expeditious, low cost access to this spectrum for rural wireless Internet service providers ("WISPs") and (ii) promote efficient use of this spectrum in congested areas. However, the new rules will not accomplish the FCC's stated objectives.

Indeed, the contention-based protocol requirement and the related sharing provision in the new rules (hereinafter, the "contention-based

[1] In the Matter of Wireless Operations in the 3650-3700 MHz Band; Rules for Wireless Broadband Services in the 3650-3700 MHz Band; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band; and Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, ET Docket Nos. 04-151, 02-380, 98-237, WT Docket No. 05-96, *Report and Order and Memorandum Opinion and Order*, rel. Mar. 16, 2005 ("*3650 MHz Band Order*").

protocol") will have significant unintended negative consequences for the deployment of wireless broadband services in both rural and congested areas. Moreover, the contention-based protocol – as a means to solve "tragedy of the commons" problems inherent in non-exclusive licensed use for long range, high power services such as those envisioned in the 3650 MHz band – will be severely problematic, and likely infeasible.

For these reasons, Petitioners recommend that the Commission promptly reconsider the *3650 MHz Band Order* and modify its rules to prescribe non-exclusive licensed use without the contention-based protocol in rural areas and exclusive licensed use in the Top 50 Metropolitan Statistical Areas ("MSAs"). Pursuant to these modified rules, the 3650 MHz band will be allocated in a manner which will achieve the FCC's stated goals.

II. THE NEW RULES SET FORTH IN THE *3650 MHZ BAND ORDER* SEEK TO ACHIEVE LAUDABLE OBJECTIVES

In the *Notice of Proposed Rulemaking* in this proceeding[2] and the *3650 MHz Band Order*, the Commission set forth two primary objectives. First, the FCC sought to provide expeditious, low cost access to the 3650 MHz band

[2] In the Matter of Unlicensed Operation in the Band 3650 – 3700 MHz; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band; and Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, ET Docket Nos. 04-151, 02-380, 98-237, *Notice of Proposed Rulemaking* , rel. Apr. 23, 2004 ("*3650 MHz Band NPRM*").

for rural WISPs.[3] Second, the Commission sought to promote efficient use of the 3650 MHz band in congested areas.[4]

In an effort to achieve these laudable goals, the FCC recently adopted new rules for operation in the 3650 MHz band.[5] The rules generally "provide for nationwide, non-exclusive licensing of terrestrial operations, utilizing technology with a contention-based protocol, in the 3650 MHz band."[6]

Specifically, the new rules exhort "[a]ll applicants and licensees [to] cooperate in the selection and use of frequencies in the 3650–3700 MHz band in order to minimize the potential for interference and make the most effective use of the authorized facilities….".[7] To this end, the rules implement "a streamlined licensing [and registration] mechanism with minimal regulatory entry requirements[,]" whereby "all licensees [are urged

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[3] *See, e.g., 3650 MHz Band NPRM* at 2 (stating a goal of "foster[ing] the introduction of new and advanced services to the American public, especially in rural areas"); *id.* at 3 (stating a goal of "facilitat[ing] the rapid deployment of advanced services and technologies to all Americans, especially in rural areas"); *id.* ("Ultimately, our goal is to … foster the introduction of new and advanced services."); *3650 MHz Band Order* at 2-3 (stating a goal of "further[ing] deployment of advanced telecommunications services to all Americans, especially in the rural heartland"); *id.* at 7 (stating a goal of "stimulat[ing] the rapid expansion of broadband services – especially in America's rural heartland"); *id.* (stating a goal of "provid[ing] additional spectrum to WISPs … for backhaul and other broadband purposes such as community networks – at low entry costs and with minimal regulatory delay"); *id.* at 8 (stating a goal of "facilitat[ing] the rapid deployment of advanced telecommunications services and technologies to all Americans").

[4] *See, e.g., 3650 MHz Band NPRM* at 2 (stating a goal of "maximiz[ing] the efficient use of the 3650 – 3700 MHz band"); *id.* (stating a goal of "more efficient use of spectrum"); *id.* at 3 ("Ultimately, our goal is to maximize the efficient use of this band …."); *3650 MHz Band Order* at 5 (stating a goal of "more efficient use of spectrum" in the 3650 MHz band).

[5] *See generally 3650 MHz Band Order*.

[6] *Id.* at 2.

[7] *Id.* at 44.

to] register their fixed and base stations in a common database" prior to commencing operation.[8] The rules state that "[l]icensees should examine [the] database before seeking station authorization, and make every effort to ensure that their fixed and base stations operate at a location, and with technical parameters, that will minimize the potential to cause and receive interference."[9]

The new rules also "require all [fixed, base, and mobile] terrestrial operations in the 3650 MHz band to use technology that includes a contention-based protocol."[10] The new rules provide that "[l]icensees of stations suffering or causing harmful interference are expected to cooperate and resolve this problem by mutually satisfactory arrangements."[11] In this

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[8] *Id.* at 2, 7. Section 90.1305 of FCC's new rules provides:

> The 3650-3700 MHz band is licensed on the basis of nonexclusive nationwide licenses. Nonexclusive nationwide licenses will serve as a prerequisite for registering individual fixed and base stations. A licensee cannot operate a fixed or base station before registering it under its license ….

Id. at 44.

[9] *Id.* at 44.

[10] *Id.* at 7, 22-23. Section 90.7 of FCC's new rules defines a contention-based protocol as follows:

> A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate. Such a protocol may consist of procedures for initiating new transmissions, and procedures for determining the state of the channel (available or unavailable).

Id. at 43. Section 90.1319(b) of FCC's new rules provides: "Any base, fixed, or mobile station operating in the band must employ a contention-based protocol." *Id.* at 44.

[11] *Id.* at 44.

regard, the Commission states, "[w]hile terrestrial licensees in this band will not have interference protection rights of primary, exclusive use licensees, the licensing scheme imposes on all licensees the mutual obligation to cooperate and avoid harmful interference to one another."[12]

Indeed, the Commission believes that, under the new rules, "terrestrial operations will avoid interference" because the "contention-based protocol will control access to [the 3650 MHz band]"[13] and the registration and licensing mechanism will "minimize the potential for interference between stations."[14] The FCC also believes that the newly adopted "licensing scheme … will provide an opportunity for the introduction of a variety of new wireless broadband services and technologies, such as WiMAX."[15] Thus, the Commission concludes that "allowing wireless providers access to the entire 3650 MHz band[,] through a non-exclusive, nationwide licensing scheme that includes the registration of fixed and base stations, serves the public interest best."[16]

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[12] *Id.* at 7, 11. Section 90.1319(a) of FCC's new rules provides: "Channels in this band are available on a shared basis only and will not be assigned for the use of any licensee." *Id.* at 44.

[13] *Id.* at 7.

[14] *Id.*

[15] *Id.* at 2. Indeed, the 3650 MHz band is key for WiMAX as it will harmonize the service on a global basis. This band is allocated on a global basis for Fixed Wireless Access and is the most commonly used band for WiMAX.

[16] *Id.* at 10.

III. THE NEW 3650 MHZ BAND RULES – BASED ON A CONTENTION PROTOCOL REQUIREMENT – WILL NOT ACCOMPLISH THE FCC'S STATED GOALS

Petitioners support the laudable objectives that the FCC seeks to accomplish in the *3650 MHz Band Order*. However, we believe that the contention-based protocol will have significant unintended negative consequences for the deployment of wireless broadband services in both rural and congested areas. Moreover, we believe that contention protocols – as a means to solve "tragedy of the commons" problems inherent in unlicensed, or non-exclusively licensed,[17] spectrum use for long range, high power services[18] – would be severely problematic, and likely infeasible, from both a policy and a practical/technical standpoint.

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[17] Petitioners point out that non-exclusive licensed use and unlicensed use are equally susceptible to "tragedy of the commons" problems where there is contention among competing long range, high power uses.

[18] If a resource is scarce (in that many people contend for its use), then a commons regime will be afflicted with the "tragedy of the commons," in which the resource is overused; in spectrum terms, this overuse results in interference. Gerald R. Faulhaber & David J. Farber, "Spectrum Management: Property Rights, Markets, and the Commons," Working Paper 02-12, AEI-Brookings Joint Center, Dec. 2002, at 13 (available online at <http://rider.wharton.upenn.edu/~faulhabe/SPECTRUM_MANAGEMENTv51.pdf>). With respect to broadband service, "any given user has an interest in ensuring that her message gets through, even if that means increasing power or the number of messages sent … such that others' messages cannot be heard. The costs created by the sender are borne by the users as a whole, but the benefits accrue to the sender." Stuart Minor Benjamin, "Does Spectrum Abundance Justify Public Control?," Progress on Point, Progress and Freedom Foundation, Apr. 2004, at 4.

A. The New Rules Are Likely to Encourage Squatting, Inefficient Use, and Administrative Delay – Thus Further Impeding the Introduction of Wireless Broadband Service in Rural Areas

The contention-based protocol and critical ambiguities in the new rules for operation in the 3650 MHz band are very likely to encourage squatting among competing providers and inefficient use, as well as cause significant administrative delay. Thus, the rules will have the unfortunate effect of impeding the introduction of wireless broadband service in rural areas (as well as the deployment of new services in congested areas).

1. Squatting and Inefficient Use

The contention-based protocol and key ambiguities in the new rules are likely to lead to various forms of squatting by competing providers and inefficient use of the 3650 MHz band. For example, the new rules are likely to encourage parties to file "squatting" applications for stations that will provide little, if any, service – for the sole purpose of impeding entry by other users. The rules attempt to deal with this situation by requiring licensees to delete registrations for unused fixed and base stations; however, the rules do not define the term "unused" or set up a time limit for deleting these stations. As written, the rules will very likely encourage users to uncooperatively "game" the system by engaging in another form of squatting – in this case, failing to delete unused stations – in order to prevent others from entering the market.

In addition, critical ambiguities in the new rules are likely to lead to inefficient use of the 3650 MHz band. The rules state that "[l]icensees should … make *every effort* to ensure that their fixed and base stations operate at a location, and with technical parameters, that will minimize the potential to cause and receive interference."[19] Yet, the Commission does not define what it means by "every effort … to … minimize… interference." Interpreted most strictly, the rule could require new entrants to take all technically feasible actions to avoid interference – even if such actions would be economically impracticable. Indeed, it is unclear what technical and economic tradeoffs new users are expected to make in order to protect incumbents.

Regardless of whether or not the FCC clarifies this obligation, the new rules are likely to encourage inefficient use of the 3650 MHz band. On the one hand, if the Commission does not clarify the obligation of new users to make "every effort … to … minimize… interference," there is a significant risk of squatting by incumbents. On the other hand, if the FCC does clarify the obligation of new entrants with too much rigor or specificity, it risks erecting barriers that would effectively preclude new users from entering the market. Either way, the new rules are likely to result in inefficient use of the 3650 MHz band.

2. Administrative Delay

[19] *3650 MHz Band Order* at 44 (emphasis added).

The new rules will create substantial administrative delay for at least two reasons. First, critical ambiguities in the new rules are likely to lead to confusion and disputes that could significantly slow the launch of new services. For example, the new rules require registration of fixed or base stations before use, but do not set forth a time frame in which service must be launched following registration. Similarly, as noted above, although the new rules require licensees to delete registrations for unused stations, the FCC has not defined "unused" or set up a time limit for deletion. Also, as noted above, the Commission does not define what is meant by the obligation of new users to make "every effort … to … minimize… interference." All of these ambiguities can be expected to create disputes and additional investment risk.

Second, in order for the administrative approval process for the contention-based protocol to have any "teeth," it will likely take a substantial amount of time to complete. Under the new rules, the Commission will have to determine at the time of application whether the specific technology proposed complies with the contention-based protocol.[20] Users are likely to try to "game" the system in order to achieve a marketplace advantage. On

[20] Notably, this determination would require the FCC to become intimately involved in the standards setting process – a huge step backwards from the current "technology neutral" approach, whereby the agency establishes power and frequency limits and then lets the industry develop standards to comply with these limits. Under this unfortunate scenario, the IEEE 802.16 (WiMAX) standard, for example, would not meet the criteria for operation in the 3650 MHz band, as it does not contain the requisite contention-based protocol. Under the new rules, the IEEE and similar entities could no longer develop such standards in the normal process (*i.e.*, develop standards to meet an FCC ruling) because the FCC would now be determining whether a particular technology meets their criteria.

the one hand, users will have incentives to circumvent, or minimize, the contention protocol requirement, if such behavior will reduce their cost and/or give them a time-to-market benefit. On the other hand, users will have incentives to delay approval of competing technical applications where that behavior will give them a marketplace advantage. Sorting through the various proposals, opposing claims, and counterclaims will significantly delay the administrative process. Indeed, if recent standards and testing activity is any indication – *e.g.*, the 1 year (ongoing) IEEE deadlock in establishing ultra wide band standards and the 2½ year delay establishing rules for Wi-Fi and Home RF spread spectrum devices – debates could drag on for years regarding 3650 MHz band threshold levels, signatures needed to assure non-interference, and testing methods for determining compliance with the new rules.

B. "Listen Before Talk" Contention-Based Protocols Do Not Work Well for Long Range, High Power Services – Thus Failing to Solve the "Commons" Problems

The Commission suggests that a "listen before talk" ("LBT") scheme, such as Carrier Sense Multiple Access with Collision Avoidance ("CSMA/CA") used by unlicensed Wi-Fi devices, provides a good model for a contention-based protocol in the 3650 MHz band.[21] However, contention-based protocols do not efficiently solve "tragedy of the commons" and resulting interference problems inherent in unlicensed, or non-exclusive licensed, use for long

[21] *3650 MHz Band Order* at 22.

range, high power services. Indeed, LBT, or sensing, contention-based protocol techniques only work well for short range, low power applications like Wi-Fi where control resides in one entity or operator-to-operator voluntary cooperation is feasible; LBT techniques do not work well for long range, high power services such as those envisioned in the 3650 MHz band where there will be significant contention among competing uses.

1. Contention Issues

LBT works well for Wi-Fi because the service is a very short range, or local, application and uses a relatively large amount of spectrum.[22] This local area network arrangement allows users to effectively resolve contention issues, such as interference from non-Wi-Fi telephones, because it relies upon de facto ownership rights. For example, Thomas Hazlett, a leading economist and noted commentator on spectrum policy, explains how one user resolved contention issues that arose when his notebook Wi-Fi modem interfered with his cordless phone; the user "replaced the expensive 2.4 gigahertz phones with [cheaper] 900 megahertz ones, problem solved. Later, wanting the caller ID feature on the 2.4 GHz phone, [he] reconnected it in a different location, trading off a smaller amount of interference for the added feature."[23]

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[22] In this regard, Petitioners note that Wi-Fi works because approximately a dozen users (*i.e.*, a very limited number of users) are sharing 90 MHz of spectrum. In contrast, the FCC's new rules for the 3650 MHz band would allow dozens, or even hundreds, of users to share a mere 50 MHz. That many users trying to access this limited amount of spectrum would be detrimental to transmission capacity – causing it to degenerate to something less than broadband or even no transmission at all.

[23] Thomas Hazlett, Sr. Fellow, Manhattan Institute for Policy Research, "Missing the Next (Radio) Wave: The FCC Leaves Tomorrow's Promising Wireless Technologies on the Beach,"

Because all of the pertinent devices were located in the user's house (and thus were under his exclusive control), he was successful in resolving contention issues as they arose.

Indeed, Wi-Fi performs optimally where control resides in one local entity. Schools and businesses successfully deploy hotspots, with IT departments configuring networks to optimize local airwaves. To retain control, these entities password-protect access and prohibit unauthorized access points. Similarly, in U.S. airports, airlines that track luggage via short range transmissions must use, and pay for, airport owned Wi-Fi systems. In all of these examples, Wi-Fi works well because it is a localized unlicensed application.[24]

When unlicensed transmissions go beyond the bounds of a home, school, or office, however, a "tragedy of the commons" is likely to take place.[25] That is, when WISPs in congested areas attempt to use unlicensed, or non-exclusively licensed, bands – where there can be dozens or even hundreds of simultaneous users – significant interference issues tend to emerge as operator-to-operator voluntary cooperation is not feasible.[26]

Barron's, Aug. 2, 2004 (available online at < http://www.manhattan-institute.org/html/_barrons-missing_the_next.htm>).

[24] *Id.*

[25] Moreover, this problem becomes even more dramatic when consumers seek to use applications such as VoIP which require low levels of interference to meet consumer expectations for high quality of service.

[26] Hazlett. For example, the congestion of WISPs in the 2.4 GHz band – and the resulting "tragedy of the commons" problem – has led to FCC to believe that it needs to allocate more

Accordingly, LBT does not work well for large area networks (of many square miles) needed to operate the long range, high power services envisioned in the 3650 MHz band (*e.g.*, WiMAX). In fact, utilizing a LBT mechanism for service to a large area or town would essentially require the entire town to be quiet, or "listen," in order for one user to successfully access the network.[27] Thus, it is not surprising that "[m]ost of the deployments of mesh today have been for police and fire departments setting up relatively small scale ad hoc networks in low traffic situations. [These] approaches can work acceptably in such [small, uncongested] environments, but *bandwidth falls off a cliff* when the numbers of simultaneous users and resultant traffic increase."[28] In fact, attempting to apply the LBT technique to dozens or even hundreds of simultaneous users would make a network virtually useless – thereby undercutting the Commission's assumption that the rules will "allow efficient use of this spectrum by multiple users without *significant* degradation of service."[29]

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spectrum for these entities. Apparently, LBT cannot and has not been successful in solving this problem.

[27] This limitation of LBT techniques has been well documented by the engineering community. *See, e.g.*, Piyush Gupta *et al.*, "An Experimental Scaling Law for Ad Hoc Networks," May 16, 2001 (available online at < http://black.csl.uiuc.edu/~prkumar/ps_files/exp.pdf>) (showing that, for one Wi-Fi integrated system, throughput dramatically drops off with only 6 nodes, or users).

[28] Francis da Costa & Sriram Dyanandan, "Multi-Radio Meshes Best for City Wi-Fi," Compliance Pipeline, Mar. 28, 2005 (emphasis added) (available online at <http://www.compliancepipeline.com/159905154>).

[29] *3650 MHz Band Order* at 11 (emphasis added).

2. Sensing

In order for LBT to work effectively, a device must be able to sense the signals of other receivers in its area at a very low threshold. In this manner, the device can ensure that the base station is a sufficient distance from these potential victim receivers so as not to cause any harmful interference. Thus, LBT works well for Wi-Fi because the access points (or base stations) and client devices are almost always very close in proximity (typically only tens of meters apart) – so detection at a very low threshold is feasible.

In the case of longer range services such as WiMAX, the potential victim receivers could be located hundreds or thousands of meters away from the companion base station and could be transmitting a relatively weak signal – such that detection at a very low threshold would be highly unlikely (especially where a victim receiver is located at the edge of the interfering device's potential service area). In addition, LBT mechanisms require a large margin of error (approximately 20–30 dB) to account for possible "hidden node" situations.[30] Accordingly, an LBT contention-based protocol will not work for the long range services anticipated in the 3650 MHz band.

3. Directional Antennas

[30] "The hidden node problem refers to the case of a signal that reaches a desired receiver near the sensor, but is undetected at the sensor due to local terrain features…." *Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies*, Notice of Proposed Rulemaking and Order, ET Docket No. 03-108, rel. Dec. 30, 2003, at 10 n.35.

LBT contention-based protocols do not work well with directional antennas because such antennas can only "listen" in one direction and LBT requires omnidirectional "listening" in order to work effectively. In fact, the directional "listening" of these antennas greatly magnifies the aforementioned "hidden node" problem inherent in LBT systems; the transmitter can "hear" (and consequently transmit to) the victim receiver, but cannot "hear" or receive signals from the transmitter attempting to communicate with the victim receiver.

Yet, directional antennas are a key component of long range wireless broadband applications like those envisioned in the 3650 MHz band, including WiMAX. Advanced antenna techniques, such as Adaptive Antenna Systems ("AAS"), are integral to WiMAX. AAS consist of several distinct directional antennas, each of which receives or transmits a signal with a different phase (*i.e.*, a time delay with respect to a given reference). The signals combine to form a beam, which can be directed toward a particular user and away from interfering systems, thereby greatly increasing spectral efficiency.

Thus, directional antennas allow service providers to offer much higher signal quality to their subscribers – while simultaneously increasing the base station's ability to receive signals from lower power client devices. They also are critical to frequency reuse in cellular-type architectures.[31] Accordingly,

[31] Petitioners note that wireless broadband and cellular architectures are quite similar – especially with respect to the use of directional antennas.

WiMAX and similar wireless broadband services function more effectively with the use of directional antennas.

In sum, contention-based protocols, such as LBT, do not work efficiently as a means to solve "tragedy of the commons" problems inherent in unlicensed, or non-exclusively licensed, use for long range, high power services – especially in congested areas. As two leading commentators have concluded, "high power … uses … fare poorly in a commons [*i.e.*, non-exclusive licensed] model as there is no guarantee of non-interference from other … users[,]" and, "in th[e] long run view, a commons regime is quite limiting, and another regime change to markets will be required."[32]

IV. PETITIONERS PROPOSE RULES THAT MEET THE NEEDS OF RURAL WISPs AND PROMOTE EFFICIENT SPECTRUM USE IN CONGESTED AREAS – THUS ACHIEVING THE FCC'S GOALS

Petitioners believe that the 3650 MHz band should be allocated in a manner which would provide expeditious, low cost access to this spectrum for rural WISPs and promote efficient use of this spectrum in congested areas. Specifically, we propose that the FCC retain its current proposal with the following modifications: (i) retain non-exclusive licensed use in rural areas (*i.e.*, outside the Top 50 MSAs),[33] but remove the contention-based protocol

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[32] Faulhaber & Farber at 19.

[33] The Top 50 MSAs refer to the 50 largest Metropolitan Statistical Areas based on population.

requirement; and (ii) prescribe exclusive licensed use in the Top 50 MSAs. We believe that this compromise proposal addresses the needs of WISPs in rural areas for a rapid introduction of wireless broadband service – without sacrificing efficient spectrum use in congested areas.

A. The New Rules for the 3650 MHz Band Should Retain Non-Exclusive Licensed Use in Rural Areas, But Eliminate the Contention-Based Protocol

For the reasons stated above, Petitioners propose that the Commission remove the contention-based protocol from the new rules for the 3650 MHz band for all markets (*i.e.*, rural areas and the Top 50 MSAs). It is a "cure worse than the disease." Specifically, Petitioners propose that the title of Section 90.1319 of the new rules be changed to "Policies governing the *non-exclusive licensed* use of the 3650-3700 MHZ band (outside the Top 50 MSAs)." We also propose that paragraphs (b) and (c) of Section 90.1319, the contention-based protocol requirement and the related sharing provision, be removed.[34]

Moreover, in order to facilitate the efficient resolution of interference issues and allow for the co-existence of exclusive and non-exclusive licensed use in adjacent areas, we propose that the Commission clearly establish licensee rights – *i.e.*, set the signal strength limit on the geographical border of the licensee's service area. Thus, Petitioners propose that Section 90.1322, "Signal strength limits," be added to the new rules and provide as follows:

[34] Together, with Petitioners' proposed modifications to § 90.1307 of the Commission's rules, the contention-based protocol is removed for all markets (*i.e.*, rural areas and Top 50 MSAs). *See* Section IV. B.

§ 90.1322. Signal strength limits.

The predicted or measured median field strength at any location on the geographical border of a licensee's service area shall not exceed the value specified unless the adjacent affected service area licensee(s) agree(s) to a different field strength. The value applies to both the initially offered service areas and to partitioned service areas.

(1) 3650-3700 MHz bands: 47 dBμV/m.

Furthermore, we propose that the power limit in Section 90.1321, "Power and antenna limits," subsection (c), be increased to a maximum 5 watt EIRP over a 25 megahertz bandwidth for mobile units in non-exclusive license use. Petitioners believe that this increase in power will provide more meaningful coverage in rural areas, while allowing for expeditious, low cost access to the 3650 MHz band for rural WISPs. We also believe that the existing limit of 40 milliwatts in any one megahertz slice of spectrum is unnecessarily low given the addition of the 47 dBμV/m signal strength limit, the existing rules to protect grandfathered satellite earth stations and federal government radiolocation facilities, and the RF exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of the Commission's rules.

B. The New Rules for the 3650 MHz Band Should Prescribe Exclusive Licensed Use in the Top 50 MSAs

In large urban areas where contention is likely, "tragedy of the commons" problems could be severe. Accordingly, Petitioners propose that the Commission modify the new rules for operation in the 3650 MHz band to prescribe exclusive licensed use in the Top 50 MSAs. We believe that

exclusive licensing will promote the most efficient use of this spectrum, as it solves "tragedy of the commons" problems and is the best way to foster long range, wireless broadband deployment in more crowded areas.

In particular, Petitioners believe that exclusive licensing in the Top 50 MSAs will promote optimal quality of service ("QoS") and strong business investment certainty in these markets;[35] such results are not possible with self-coordinated contention protocols based on the mutual obligation to cooperate.[36] Companies are more willing to risk capital investments where they can better control spectrum access and thus create optimum QoS for their subscribers.

Billions of dollars of investment in the mobile phone industry illustrates this point. "Each of today's mobile phone carriers could save billions … by transmitting in unlicensed bands. While operators are happy to use unlicensed bands in *very local* [and uncongested] applications, they are unwilling to sink billions to create ubiquitous [wide area] coverage, because the cost of 'free' bandwidth – complying with government power limits,

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[35] *See* Hazlett ("Exclusivity, protecting investment in new networks, is delivered via licensed frequencies."); "WCA to Seek Reconsideration of 3650-3700 MHz Band Order," Comm. Daily, May 5, 2005 (citing an industry source) ("If you are the first broadband operator in the band and you deploy the network, then what happens when a second [operator] comes into the band? …. If you can't ensure that there is no interference, how are you going to provide a quality of service to your consumers?").

[36] As discussed above, the contention-based protocol merely "imposes on all licenses the *mutual obligation to cooperate* and avoid harmful interference to one another." *3650 MHz Band Order* at 7, 11 (emphasis added).

putting up with competing users – is too high."[37] For these reasons, "[t]he $150 billion spent to build six national wireless telephone networks depends on airwaves managed by licensees who act as de facto spectrum owners…. This [exclusivity has] prove[n] extremely valuable in national deployments providing service beyond pinpoint hotspot locations…. Exactly the same success would extend to data services, were additional [exclusive] licensed spectrum made available."[38]

Without such exclusivity, the Commission risks non-deployment of promising new wireless technologies in the 3650 MHz band and thus the most efficient use of this spectrum.[39] "Such valuable wide area options, *excluded by unlicensed rules*, could be neatly deployed on exclusively assigned spectrum."[40]

Furthermore, an exclusive licensing approach in the 3650 MHz band for the Top 50 MSAs should not create significant market power problems. In these congested markets, there are or will likely be several wired and wireless broadband alternatives, including DSL and cable modem and the numerous advanced wireless services bands. Thus, exclusive licensing will not only promote the most efficient use of this spectrum in congested areas,

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[37] Hazlett (emphasis added).

[38] *Id.*

[39] Petitioners further note that, despite the success of unlicensed WISPs in some rural areas, unlicensed providers are a mere blip (if at all) on the radar screen for broadband service in major markets. Indeed, as discussed above, LBT techniques cannot work in congested areas.

[40] Hazlett (emphasis added).

but also will offer an additional broadband alternative in the more crowded markets – thereby producing consumer benefits in the form of increased competition and lower prices.

In order to best facilitate the delivery of broadband service in the more congested markets, we propose that Section 90.1307, "Licensing," of the Commission's new rules for the 3650 MHz band be modified to include *exclusive licensed* use in the Top 50 MSAs. Specifically, Petitioners believe that two blocks of 25 megahertz each should be exclusively licensed in these markets. Thus, we propose that Section 90.1307 be modified to provide as follows:

> § 90.1307. Licensing.
>
> (a) *Exclusive licensing*.
>
> (1) Service areas are the Top 50 MSAs.
>
> (2) 2x25 MHz adjacent blocks within the 3650-3700 MHz band.
>
> (3) Blanket licenses are granted for each market and frequency block. Blanket licenses also cover all fixed stations anywhere within the service area.
>
> (b) *Non-exclusive licensing*.
>
> (1) For areas not covered in (a)(1) of this section (*i.e.*, markets outside the Top 50 MSAs), the 3650-3700 MHz band is assigned on the basis of non-exclusive nationwide licenses. Such licenses will serve as a prerequisite for registering individual fixed and base stations. A licensee may not operate a fixed or base station before registering it under its license. Licensees

must delete registrations for any and all unused fixed and base stations.

We believe that these proposed rules, as modified to implement exclusive licensed use in the Top 50 MSAs, will promote the most efficient use of the 3650 MHz band. Indeed, the proposed rules will prevent "tragedy of the commons" problems and foster long range, wireless broadband deployment in these congested areas.

V. CONCLUSION

For the reasons set forth above, Petitioners recommend that the Commission promptly reconsider the *3650 MHz Band Order* and modify its rules for the 3650 MHz band to prescribe non-exclusive licensed use without the contention-based protocol in rural areas and exclusive licensed use in the Top 50 MSAs. Pursuant to these modified rules, the 3650 MHz band will be allocated in a manner which will meet the FCC's dual goals of providing expeditious, low cost access to this spectrum for rural WISPs and promoting efficient use of this spectrum in congested areas.

Respectfully submitted,

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